

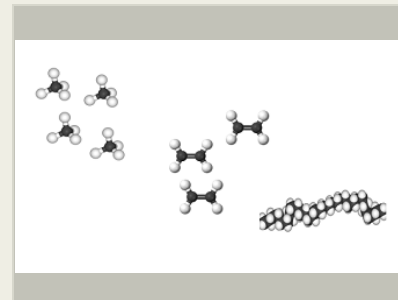
ISP3: In-Situ Printing Plastic Production System for Space Additive Manufacturing, Phase I

Completed Technology Project (2016 - 2016)



Project Introduction

The ability to "live off of the land" via in-situ resource utilization has long been recognized as a key capability for enabling the affordable development of space. While most of the focus has been on the production of bulk quantities of rocket propellants such as Liquid Methane, Liquid Hydrogen, and Liquid Oxygen from extraterrestrial water and carbon dioxide sources, there has recently been an increase of interest in the production of structural materials as well from in-situ resources, particularly materials that can be used for Additive Manufacturing. For this Phase 1 effort, Altius and its team members propose development of an In-Situ Printing Plastics Production (ISP3) system, that can take methane and oxygen inputs from various in-situ sources, and convert them into High Density Polyethylene (HDPE) filaments for use in a fused deposition modeling (FDM) style 3D printer, such as those developed by Made In Space. In Phase 1, Altius and its team members will simulate and test the three primary subsystems for ISP3: an Oxidative Coupling of Methane reactor that converts the methane into olefins and water, an olefin separation membrane that separates olefins from other outputs of the OCM reactor, and an innovative polymerization reactor that does not use physical catalysts for initiating the polyethylene polymerization reaction. Successful completion of these experiments and subsequent scaling and process refinement tasks will result in an updated ISP3 process design for Phase 2, raising the TRL of ISP3 from TRL 2 to TRL3. Phase 2 will focus on production of an integrated brassboard ISP3 prototype capable of producing small quantities of HDPE filament from methane and oxygen inputs. This will raise the system TRL to 5.

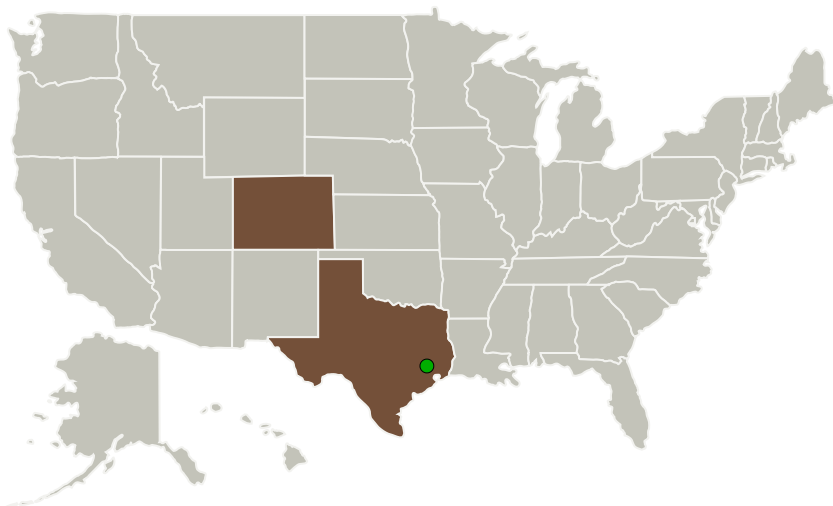


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Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Altius Space Machines, Inc.	Lead Organization	Industry	Broomfield, Colorado
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Colorado	Texas

Project Transitions

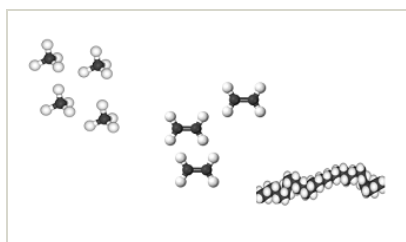
▶ **June 2016:** Project Start

✓ **December 2016:** Closed out

Closeout Documentation:

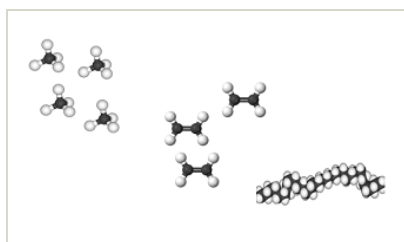
- Final Summary Chart(<https://techport.nasa.gov/file/140457>)

Images



Briefing Chart Image

ISP3: In-Situ Printing Plastic Production System for Space Additive Manufacturing, Phase I (<https://techport.nasa.gov/image/132360>)



Final Summary Chart Image

ISP3: In-Situ Printing Plastic Production System for Space Additive Manufacturing, Phase I Project Image (<https://techport.nasa.gov/image/130894>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Altius Space Machines, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

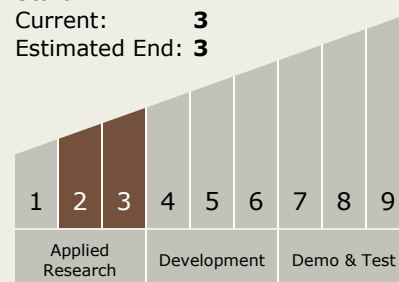
Carlos Torrez

Principal Investigator:

Nathan A Davis

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



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Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - └ TX07.2 Mission Infrastructure, Sustainability, and Supportability
 - └ TX07.2.2 In-Situ Manufacturing, Maintenance, and Repair

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System